Introduction

The building of polyelectrolyte multilayered nano-sized capsules using layer-by-layer (LbL) self-assembly deposition method was used (Scheme 1) [1]. The shell of the capsules were constructed with type-I collagen (COL) and hyaluronic acid (HA) (Fig. 1). The LbL deposition was done by consecutive adsorption of appositively charged polyelectrolytes onto the surface of colloidal particles, calcium carbonate microparticles. After the assembling, the core was removed (Fig. 2). The release rates were determined using albumin-FITC as a model protein (Fig. 3). The albumin-FITC was loaded into the core and its release from the capsules was assessed using collagenase. The release kinetics was controlled by modulating the number of the layers.

COL/HA LbL-assembled capsules preparation and identification

Fig.1 Confocal Laser microscopy images of COL/HA-capsules. CaCO3 was loaded with rhodamine-BSA by coprecipitation method and used as a template core for LbL deposition of six double layer of COL/HA.

Fig.2 Confocal Laser microscopy images of a single COL/HA-capsule with rhodamine-BSA encapsulated, after dissolution of the template (CaCO3) with 1M HCL.

Conclusions

In this work a novel enzyme-responsive microcapsules were developed. Protein-loaded hollow microcapsules were successfully prepared by LbL assembling of appositively charged polyelectrolytes (COL and HA) onto CaCO3 template core. The release profile of the encapsulated protein was due to the collagenase degradation of capsule shells. By exploiting the degradation efficiency of the hollow capsules, it should be possible to control the release of encapsulated protein from the hollow capsules by controlling the number of shell layers and/or cross-linking of the collagen protein. Both COL and HA are components of extracellular matrix being biocompatible and biodegradable. Due to these features inclusion of medical or therapeutic agents into COL/HA assembled capsules make them suitable as drug delivery systems as well as tuneable biomaterial interfaces [2].

References


Collagenase induced release study using albumin-FITC as a model protein

The release behaviors of the encapsulated FITC-albumin from the hollow capsules were examined in the presence and absence of collagenase. The hollow capsules encapsulating FITC-albumin were immersed into a collagenase solution and the amount of release FITC-albumin was determined by fluorescent spectra (Fig. 3). In the case of the absence of collagenase at 37°C, a small amount of protein is released. This result is due to increasing the capsule permeability with the raising temperature medium. On the other hand, in the presence of collagenase, protein release was clearly observed indicating that the degradation of the hollow capsules has occurred. The maximum release was achieved after 4 hours incubation at 37°C. The amount of the protein release from the capsules is dependent of the enzyme concentration.

Fig.3 FITC-albumin release course from COL/HA capsules by action of collagenase. The control (in absence of collagenase) and the samples in presence of collagenase at different concentrations stirred for 24 h at 37°C.